

the book before us is nothing if not scientific and modern in its treatment of the subject. It attempts in the first place to do justice to the claims of every one of the principal existing groups of animals, fairly and without favour or prejudice, giving an outline of the structure and morphology of the more important types in each class. In the second place, it introduces the reader to the fundamental conceptions and problems of zoology, such as evolution, classification and phylogeny, distribution in space and time, conjugation, fertilisation, development, and the cell theory. In a work of scope so wide and comprehensive, with at the same time such narrow limits of space, it requires much care and ingenuity to steer a just course between the Scylla of over-condensation and perplexity and the Charybdis of vague incompleteness. The inexperienced reader becomes bewildered, in the first case with excess, and in the second with lack of detail, so that he is at a loss how to sort out, or how to connect, the material which he absorbs. The danger is, therefore, that a treatise of this kind may be used less by the beginner, who requires to be stimulated and interested, than by the more advanced student, who desires merely to "look up" work he has done; in other words, that it may degenerate into a mere cram-book. It must be admitted, however, that if it is possible to succeed in such a task, the authors have done so. The book contains a great store of information, chosen with judgment and set forth with skill. In order to avoid as much as possible the dangers above pointed out, the authors have restricted the extent of ground covered by leaving out some of the less important groups, such as Chimæroids among fishes, by omitting all descriptions of extinct groups, and by dealing only very briefly with embryology. Perhaps the chief value of the work is in its numerous and admirable illustrations, of which the authors had a copious stock to draw upon in the pages of their larger two-volume "Text-Book." Amongst them are some coloured diagrams of the circulation of the blood in various types, for the most part clear enough, but Fig. 204, illustrating the circulation of a fish, certainly requires a good deal of looking at before its meaning can be grasped. The book is intended, we are told, principally for the requirements of the students in higher classes of schools; but is it necessary, even in this educational stratum, to explain the meaning of commensalism by coining and printing such a word as "messmateism," which looks at first like some new form of theosophy? These are, however, but minor points. Judged as a whole, the book is one which fills a distinct gap in zoological literature, and fills it well, as a handy book of reference, though we are inclined to think that the authors have attempted rather too much, and that the class of readers who will benefit most by their work will not be quite those for whose use the book was intended.

The second book mentioned at the head of this notice will be welcomed by many as a handy and inexpensive manual of zoology adapted to the needs of elementary, and especially medical, students, which is at the same time free from the faults and vices of the harmful, unnecessary cram-book. It is written on the same plan as the well-known "Elementary Biology" of Huxley and Martin; that is to say, a certain number of types are selected, and a connected account of each one

is given first, after which follow practical directions, necessarily rather brief, for its study and dissection. The examples selected are *Amoeba* and some other unicellular organisms, illustrative of the differences between animals and plants; *Hydra* and *Bougainvillea*; the earthworm, crayfish and pond-mussel; and the amphioxus, dogfish, frog and rabbit. The frog is taken first and dealt with in detail, occupying nearly half the book, as an introduction to biology in its various branches—anatomy, physiology, histology, embryology, classification and various biological problems. Then follow the descriptions of the other types, beginning with the unicellular forms and ending with the vertebrates; and a final chapter deals with the cell and with fertilisation and embryology. The illustrations are numerous and useful, some of them from familiar clichés, others appearing for the first time. The book, it may be safely predicted, will become popular and will run through further editions, in which, doubtless, alterations will be made to keep it up to the level of advances in science. In the present issue, the most recent standpoint of vertebrate embryology is not quite adequately represented. Thus more might have been made of the frequent occurrence of what may be termed the amphioxus stage in the embryonic development of many systems of organs in Craniata, as for instance the appearance, in the development of the vascular system, of a splanchnopleuric subintestinal vein, prior to the formation of the somatopleuric system represented by the cardinal veins, &c., and the origin of the heart itself from the anterior portion of the former system. Again, in the urogenital system the differences between pronephric and mesonephric tubules, both in development and structure, and the homology of the former with the excretory tubules of amphioxus, might at least have been alluded to. The authors do not raise the question as to whether pronephric and mesonephric tubules are to be regarded as homodynamous or not, but leave one rather with the impression that they are; it is surely time now, however, that the English, no less than the German, student (and, for that matter, the English teacher and examiner also) should be told clearly that they are not. The concluding chapter of the book might, in fact, have its interest, as well as its value, increased in many particulars, without adding half a page to its length. But this detracts little from the usefulness of the book as a guide and help to the student and teacher of zoology, and as such it may be confidently recommended.

E. A. M.

THE TEACHING OF METEOROLOGY.

Practical Exercises in Elementary Meteorology. By Robert DeCourcy Ward, Instructor in Climatology in Harvard University. Pp. viii + 195. (Boston, U.S.A.: Ginn and Co., 1899.)

M R. ROBERT D. WARD has written a book for the use of schools and training colleges, which we should think would be very popular with teachers and pupils alike. With the former, because he indicates to them the proper method of giving instruction in meteorology, and, at the same time, supplies so many valuable hints, that he makes their work more profitable, without

increasing the severity of their duties. To the latter, because his object is, among others, to turn the numerous meteorological observations that are made at many high schools to practical account, to clothe the dry bones of mere instrumental readings with an intelligent purpose, and to infuse a new and sustained interest into a mechanical routine. Nothing, we imagine, can be more wearisome than the continual record of temperature and pressure and other data of which no definite use is made. The educational value of such a practice must be very slight, and Mr. Ward has recognised the necessity of improving this mechanical record, and, at the same time, of investing the ordinary class teaching with a definite practical purpose. He has taken both pupils and teachers by the hand in a way that should produce most encouraging results. Doubtless many others have perceived defects in the methods of teaching meteorology, but it is Mr. Ward's merit that he has known how to apply a practical remedy. He, first of all, takes his pupils without instruments, and shows how much can be done by the exercise of ordinary intelligence and trained organised powers of observation. Many a teacher, we imagine, when he sees the numerous questions which Mr. Ward puts, and to which intelligent answers can be given by simple, if acute, observation, will take shame to himself that he has not adopted similar, and even extended, methods for infusing life and interest into the study of a science that is too often regarded as dull and insipid. Here is a specimen, taken at random, of what a pupil is expected to acquire from his own observations.

"Wind and Precipitation. Are any particular wind directions more likely than others to give us rain or snow? Are these the same winds as those which give us the most cloudiness? What winds are they? Has the velocity of the wind any relation to the rain or snow-storm? Does the wind blow harder, before, during, or after the rain or snow? What changes of wind direction have you noted, before, during, or after any storm? Have you noticed these same changes in other storms? Are they so common in our storms that you can make a rule as to these changes?"

None of these questions, it is to be observed, are answered. The answers are to be derived from the student's own notes, which he is shown how to make, and of which he is expected to keep a tabulated record.

Mr. Ward wisely keeps his description of instruments within very moderate bounds; such information is to be found elsewhere, and the object here is rather to induce the student to discover for himself the most important facts in weather conditions, and to proceed to the study of climate and the possibility of weather prediction. With the latter view, means are provided for constructing synoptic weather maps over the area of the United States; and the lessons to be learnt from the study of these maps are brought out by a series of pertinent questions in the manner already illustrated. After familiarity with the construction of weather maps and the method of determining gradients and similar elementary points have been acquired, the pupil is led to the study of the interrelations of the different weather elements, and particularly of the forms, dimensions and movements of cyclones and anti-cyclones, the main features of whose characteristics the pupil is taught to

derive for himself from the actual, and not specially prepared, weather maps.

A series of so-called problems in observational meteorology is added, in which the same manner of teaching is preserved. Questions connected with vertical gradients in temperature, with humidity, clouds, &c., carefully graduated according to the student's supposed progress in the study of weather phenomena, are submitted for his consideration, the object being generally to discover the explanation of observed facts. A few useful tables are also given, and in an appendix are some useful hints to teachers, which the author's experience suggests as likely to be of assistance and, at the same time, explanatory of his own purpose. The plan of the book is based on the recommendations in the Report on Geography of the Council of Ten, and is very intelligently pursued. The author shows throughout the earnestness and the capacity of a true teacher, and we hope that his book and his methods of teaching will obtain a wide currency, suggesting as they do a vast improvement on the training generally in vogue. There remains still a further question, which the author does not broach, and on which it is probably preferable to maintain a discreet silence. How far is meteorology perfected as a science to warrant its employment as an educational force, demanding the exactness, and supplying the training, which the older and more recognised means have hitherto supplied?

OUR BOOK SHELF.

Lectures on Some of the Physical Properties of Soil. By Robert Warington, M.A., F.R.S. Pp. xv + 231. (Oxford : Clarendon Press, 1900.)

THIS is a subject of deep interest to the student, and of no small practical importance to the farmer. As Mr. Warington indicates, it is one that has not received a great deal of experimental attention in this country, nor does it usually form a separate subject for class-room treatment. In England we have in the past depended chiefly on the text-books of Fream and Munro, to which may now be added some excellent American manuals, notably that by King. These lectures by Warington form a welcome addition to our literature, and they are worthy of a larger audience than that which surrounded the Sibthorpiian chair.

Two of the five chapters are concerned with the relationship of the soil to water. This is a matter which the cultivator—by attention to tillage, cropping and manures—can turn to good practical account. By draining, he can get rid of excessive moisture, while by introducing humus to a dry soil, and by the production and preservation of a fine tilth, he can conserve moisture and place it more fully at the disposal of plants. Farmers and gardeners who read these lectures will learn that there are other ways of providing crops with water than by the use of the water-cart or the watering-pan. In forestry, too, much may be done, by attention to cultural measures, to place an increased supply of water at the disposal of trees, and on these measures the success of woods on dry ground largely depends.

Possibly the chapter that deals with the movement of salts in the soil is the one that will appeal most directly to the farmer. Much of the success of manuring depends on the suitable relationship of fertilisers to soil and climate. Substances that are firmly held by the soil may be used without fear of loss even on light soil and in a district of large rainfall, whereas substances for which soil has but little affinity must be applied with much